NATURAL HISTORY GUIDE TO AMERICAN SAMOA

National Park of American Samoa

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EDITOR

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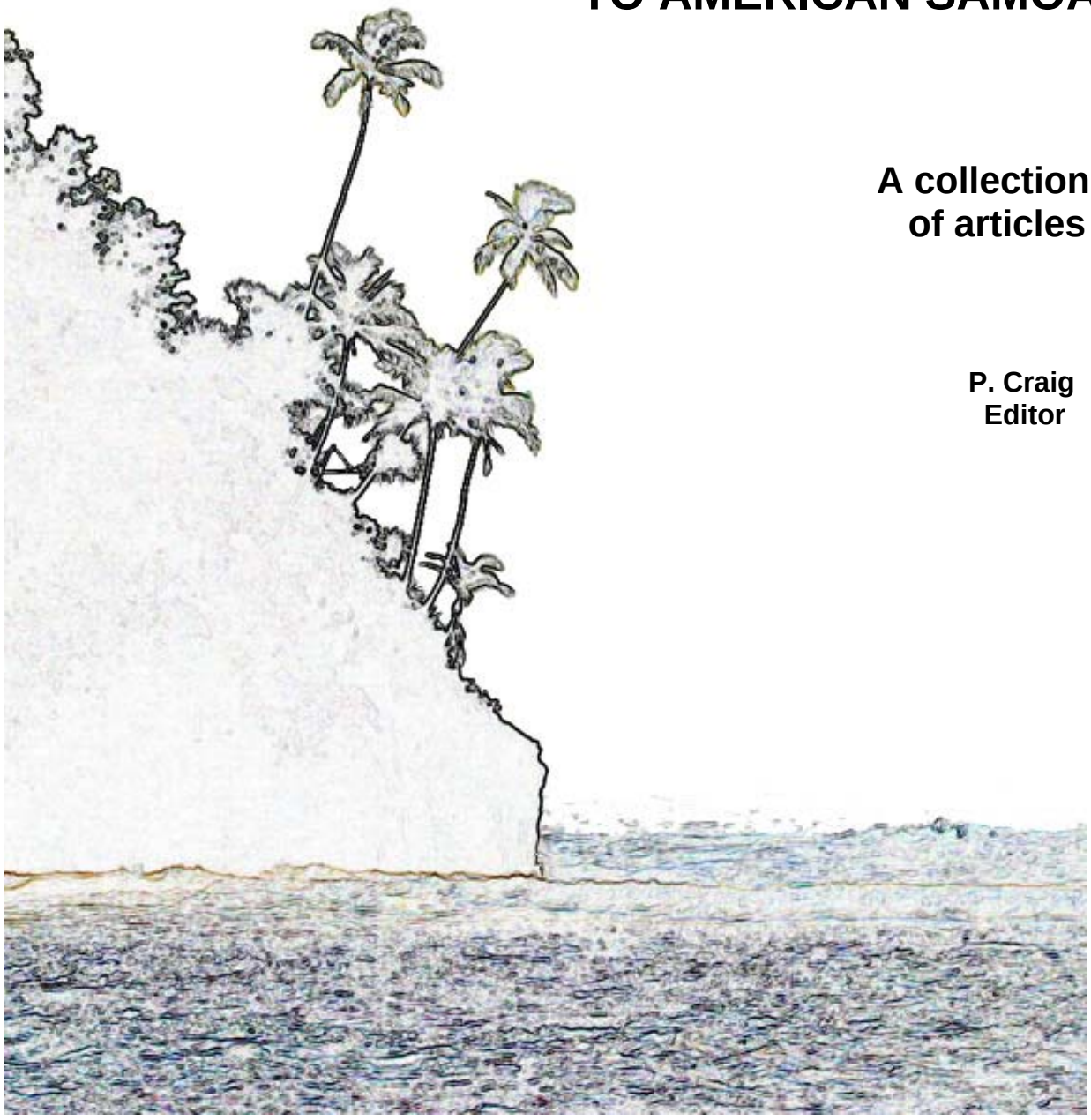

A collection of articles

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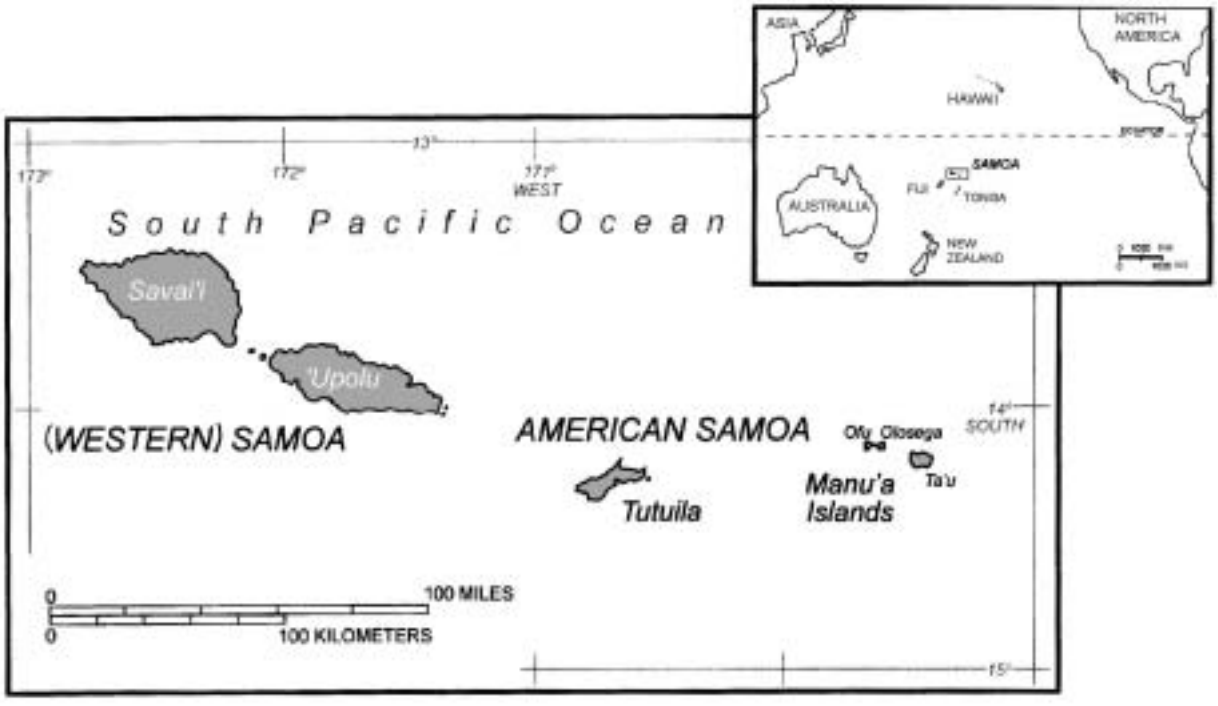
Preface & Acknowledgments

This collection of articles provides a glimpse into the marine and wildlife resources in American Samoa's tropical, oceanic environment. The articles were written by 8 biologists at the Department of Marine and Wildlife Resources (DMWR), National Park of American Samoa (NPS) and Land Grant Program at the American Samoa Community College (ASCC). Our purpose in writing these was to make the results of our studies available to local teachers, students, visitors and whoever else might be curious about Samoa's unique environment. The use of English, Samoan and scientific names of plants and animals varies among chapters, so the reader is referred to cross- reference lists in the mammal and reptile checklist (Chapter 18), bird checklist (Chapter 27), and the plant index at the end of this report.

Several individuals, organizations and publishers have kindly allowed their illustrations to be reprinted in this volume; their credits are listed on page 76. Special thanks to Dick Watling for permission to reproduce the excellent pictures from his books “Birds of Fiji, Tonga and Samoa” and “Birds of Fiji and western Polynesia” (Pacificbirds.com).

Joshua Seamon, Matt Le'i, and Larry Basch provided comments throughout the text, and Tavita Togia and Art Whistler provided the plant reference list on page 75. Support to DMWR was provided by the Federal Aid in Sportfish and Wildlife Restoration Acts.


United States mainland
NORTH PACIFIC OCEAN
INTERNATIONAL DATE LINE
Hawaii
Equator
SAMOA ISLANDS
Fiji
Australia
Tahiti
Easter Island
Tonga
SOUTH PACIFIC OCEAN
New Zealand

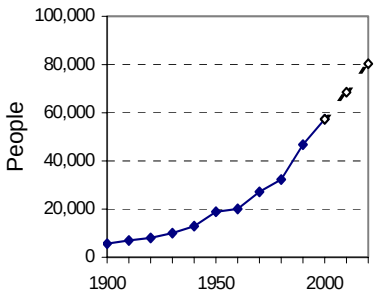

ASIA
NORTH AMERICA
HAWAII
SAMOA
FIJI
TONGA
AUSTRALIA
NEW ZEALAND
172°
171° WEST
South Pacific Ocean
Savai'i
'Upolu
(WESTERN) SAMOA
AMERICAN SAMOA
Ofu Olosega
Ta'u
Manu'a Islands
Tutuila
14° SOUTH
0 100 MILES
0 100 KILOMETERS
15°

1. Local facts and maps

Samoan Archipelago. This chain of 9 inhabited Pacific islands is located 14° south of the equator and is divided into two political entities, the US Territory of American Samoa and the neighboring independent country of (western) Samoa. The youngest islands in this chain lie towards the east (Ta'u), contrary to an earlier geological report.

Territory of American Samoa. The total land area is 76.1 square miles and includes five volcanic islands (Tutuila, Aunu'u, Ofu, Olosega, Ta'u) and two remote atolls (Rose, Swains).

Population. Polynesians arrived here about 3,000 years ago. The current population (60,000 in 2002) is growing rapidly at 2.1% per year. Most people (96%) live on Tutuila Island. The ethnic composition is approximately 90% Samoan, 4% Tongan, 2% Caucasian, and 4% others.



Topography. The main islands are steep mountains that emerge from the ocean floor about 2- 3 miles below the sea surface. Peak elevations are about 3,100 feet on Ta'u Island (Lata Mountain) and 2,142 feet on Tutuila Island (Matafao Peak).

Climate. Hot, humid and rainy year- round, but there is a long, wet summer season (October - May) and a slightly cooler and drier season (June - September). Total rainfall is 125 inches at the Tafuna airport and 200+ inches in mountainous areas.

Hurricanes. While very destructive, hurricanes (cyclones) are a natural feature of the environment in this part of the world. The most recent ones in American Samoa occurred in 1981 (Esau), 1987 (Tusi), 1990 (Ofa), and 1991 (Val).

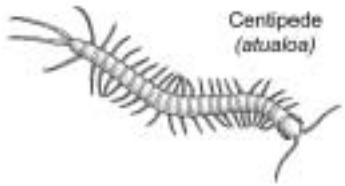
Native flora and fauna. Most native species here are closely related to those in Indonesia. Due to our remote location in the Pacific Ocean, the diversity of terrestrial species here is low: 471 flowering plants and ferns, 24 resident land and water birds, 20 resident seabirds, 3 mammals (all bats), 7 skinks, 4 geckos, 2 sea turtles, 1 snake, and other occasional visitors. In contrast, the diversity of marine species here is high: 890 coral reef fishes, over 200 corals, and a few whales and dolphins. Insects and other invertebrate species here are not well known.

Endemic species. Species found only in the Samoan Archipelago include one bird (Samoan starling) and about 32% of local plant species. Five flowering plant species are endemic to American Samoa itself. Marine endemics have not been identified, but a thorough investigation has not been conducted.

Threatened or endangered species. Federally listed species here include humpback whales and the green and hawksbill sea turtles. Additional species 'of concern' in the Territory include the sheath- tailed bat, 3 birds (Spotless Crake, Friendly Ground Dove, Many- colored Fruit Dove), several land snails, and others.

Pests and weeds (invasive non- native species). There are many: rats, 3 bird species (2 mynas and bulbuls), feral pigs, dogs, cats, toads, house gecko, tilapia and molly fishes, African snails, about 250 alien species of vascular plants (many of them weed species), and others.

Dangerous species. Few. On land, no poisonous snakes, but a bite from a large 8- inch centipede can be painful. In the ocean, sharks are generally not a problem but stepping on the poisonous spine of a stonefish can be a serious medical emergency although this rarely happens. Consumers of fish should note that ciguatera poisoning has been found (infrequently) in several snappers (locally called *mu*) and a few other fish species. Also, avoid eating any fish or invertebrate caught in Pago Pago Harbor, because they are contaminated with heavy metals and other pollutants.



Tropical diseases. Malaria is not present, but two other mosquito- transmitted diseases can occur here: dengue fever (caused by a virus) and filariasis (elephantiasis, caused by a parasitic nematode worm). However, the chance of getting either by a visitor is slight.

Conservation areas as of 2002:

Site	Year	Location	km²	acres
Rose Atoll National Wildlife Sanctuary	1973	Rose Atoll	158.8	39,251
Fagatele Bay National Marine Sanctuary	1986	Tutuila	0.7	161
National Park of American Samoa	1993	Tutuila, Ofu, Ta'u	42.6	10,520
Vaoto Territorial Marine Park	1994	Ofu	0.5	120

All fishing is prohibited at Rose Atoll, but traditional subsistence fishing is permitted at the other sites. Other 'special management areas' in the Territory include Pago Pago Harbor, Nu'uuli Pala Lagoon and Leone wetlands.

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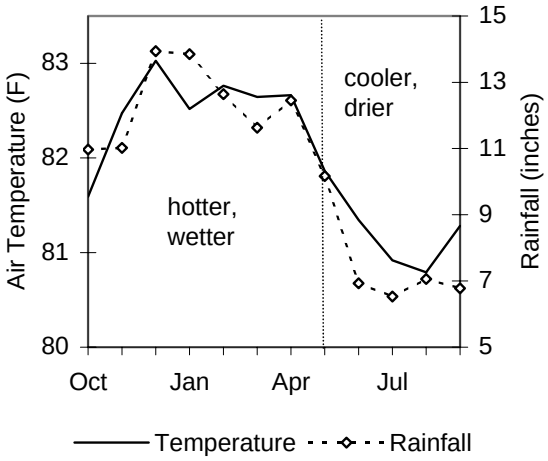
2. Seasons in Samoa

Samoa's weather may seem warm, wet and humid all year, but we do have two seasons. Not exactly summer and winter, because Tutuila is a small dot in a vast tropical ocean, so the ocean moderates our weather year- round. Our seasons are sometimes referred to as tropical wet and dry periods, although you may wonder, when is it ever dry here?

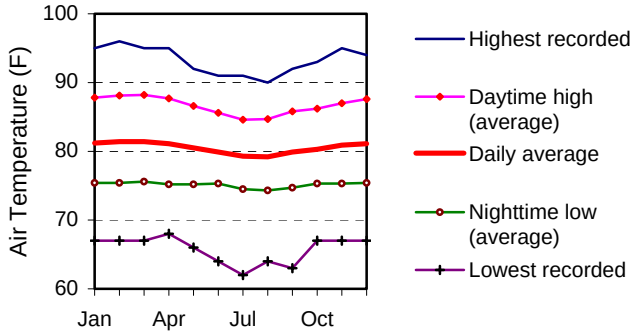
October through May is our 8- month hot and wet summer. Rainfall at the Tafuna airport weather station is about 11- 14 inches per month and air temperature (averaged over a 24- hour period) is about 82- 83° F (for the period 1990- 2002). Our 'cold' spell occurs from June through September, when averaged air temperatures plummet to 81° F and rainfall is reduced by half.



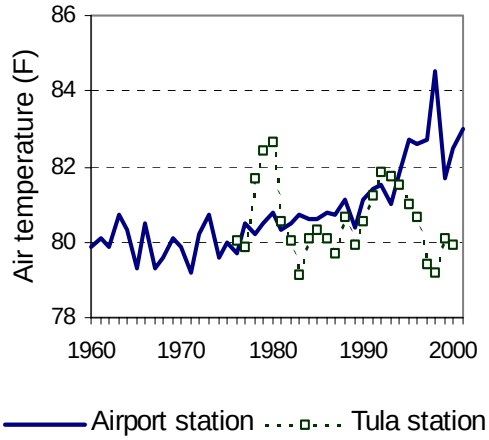
Actual rainfall can vary much more than this, as we all know. Minimum and maximum records for rainfall over a one- month period are 0.3 and 32.7 inches. The amount of rainfall we receive depends largely on where we are standing. The harbor area is very wet - - it receives 200 inches of rainfall per year. Some mountain areas may get up to 300 inches (25 feet) per year. The Tafuna plains are much drier and receive a mere 125 inches per year.

If it seems like it rains every day here, it almost does. In most years, the airport weather station detects at least a trace of rain 300 days of the year. But a noticeable amount of rain (at least one tenth of an inch) occurs on about 50% of the days of the year. But remember, the airport (where these measurements are taken) is the driest part of our island. Relative humidity at the airport fluctuates in the 80s (daily range 73- 90%).

Air temperatures in recent years typically fluctuate from nighttime lows around 77° F to afternoon highs in the upper 80s. We now average 60 days per year at 90° or above. Record highs and lows here are 96° and 62° F.



But if it feels like our climate it is getting warmer, it is, but the picture is a little complicated. We have two long- term records of air temperature in American Samoa, the NOAA weather stations at the Tafuna airport and at Tula. Temperature trends at these two sites are quite different, probably due to local conditions where the temperatures are actually measured. Temperatures measured at the airport weather station have risen steadily over the past 15 years (see graph), but no such increase has been recorded at the NOAA station in Tula. The airport station measures air temperatures at a height of about 5.5 feet above the ground, and it is located on the Tafuna Plains which is rapidly being built up with buildings and roads, so it is probably detecting a near- ground increase in temperature that is felt by us. Whether other parts of Tutuila are warming in a similar fashion is not known. In contrast, the Tula station measures air temperatures at about 50 feet above the ground, so it is less affected by near- ground conditions. It shows no increase in temperature, as would be expected at our remote oceanic location.



As summer progresses, the temperature of the ocean's surface waters also increases by 2° F. Warmer ocean temperatures, in turn, help provide the energy to start hurricanes, thus the chance of a hurricane is greatest between November and March.

Hurricane Val in 1991

Some plants and animals in Samoa schedule their activities, such as flowering or spawning, according to the seasons. These biological events tend to occur over a much longer period in the tropics compared to colder regions of the world, because the distinction between our two seasons is not great and growing conditions here are generally good year- round. Nevertheless, seasonal patterns of flowering and fruiting mean times of abundance or scarcity for some of our native wildlife, particularly the fruit bats (*pe'a*) and Pacific pigeon (*lupe*).

Some animals schedule their seasonal migrations to Samoa to avoid winters elsewhere in the world. We see more golden plovers (*tuli*) and and tourists during the October to March period when they flee winter in the northern hemisphere, while humpback whales (*tofola*) are most common here in September- October when they escape winter in the southern hemisphere.

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3. Biodiversity in our rainforests and coral reefs

There's a certain mystique about the word 'biodiversity' that seems to be associated with images of steamy jungles or wondrous new medicines, but the word usually refers to the number of species or 'species richness' of an area. One reason why tropical areas are so fascinating is that they contain the highest numbers of plant and animal species found anywhere on earth.

American Samoa sits squarely in the tropics, so we should have a high biological diversity here, but we do and we don't. There is a sharp contrast between the number of plant and animal species that live on land here (few) versus those that live in our coastal waters (many). Most small islands in the South Pacific share this characteristic.

To start at the beginning, when our islands emerged as fiery volcanos above the sea surface, they were devoid of plants or animals. As time passed and the terrain became more hospitable, life for organisms became possible, but the plants and animals still had to cross major ocean barriers to get here from someplace else.

A quick look at a map will show one reason why few land species got here. We are really quite isolated in the Pacific Ocean, far from potential sources of plants and animals. To reach our shores, organisms would either have to blow in on the wind, drift for hundreds or thousands of miles on some piece of floating debris, or be carried in by another organism like plant seeds in a bird's stomach. The species that were successful probably got here by 'island hopping' across the Pacific, spreading from island to island over the course of many thousands or millions of years.

The difficulty in getting here is best illustrated by the sparse representation of native mammal species. Over the past 1.5 million years that Tutuila Island has existed, only 3 mammal species (all bats) got here and established viable populations. Our native species list also includes about 471 flowering plants and ferns, 24 resident land and water birds, 20 resident seabirds, 7 skinks, 4 geckos, 2 sea turtles, 1 snake, and occasional other visitors (this list does not include all the introduced non- native species like rats, dogs, pigs, toads, myna birds, and many weeds).

There's a second reason for our low diversity on land - - the small size of our islands. In general, the smaller the island, the fewer the species on it. For example, tiny Rose Atoll (0.4 sq mi) supports only 5 native plant species, 21 birds (virtually all seabirds), 2 geckos, and 2 sea turtles.

So, although American Samoa technically has 'tropical rainforests' due to our high level of rainfall (200- 300 inches per year in some mountainous areas), we lack the high species richness found in the jungle rainforests of Indonesia, Africa or South America that are filled with hooting monkeys, poison dart frogs, pythons and flesh- eating piranhas.

On the other hand, because of our isolation, some terrestrial species in Samoa have evolved over many thousands of years to such an extent that they have become distinctly different species found nowhere else but here. For example, 1% of our plant species occur only in American Samoa; 32% of

our plant species and the Samoan starling (*fuia*) occur only in the Samoan archipelago (which includes western Samoa); and the Samoan fruit bat occurs only in the Samoan and Fijian islands. So, our rainforest may lack diversity, but it contains some species found nowhere else on earth.

Turning to our marine environment, we find the opposite situation. There is an incredibly diverse ecosystem just beneath the waves. Coral reefs are among the most species- rich ecosystems in the world. We have, for example, 890 nearshore fish species which is an amazingly high number compared to many other coastal areas. To get a sense of this species- rich environment, if you were to dive on our reefs once a week, you could in theory see a new fish species on every dive for 17 years.

Although coral reefs are limited to shallow waters, mostly around the fringes of islands, most coral reef species have eggs and larvae that can survive for weeks or months in the open ocean and get dispersed by ocean currents to new locations. As a result of this genetic exchange of marine organisms between islands, there are probably few marine species that are unique to the Samoan islands.

Finally, superimposed over the South Pacific region is a larger- scale pattern of species distributions. Most of our marine and land species can be traced back to the same or related species inhabiting mainland and insular southeast Asia. From that center of remarkably high diversity, rainforest and coral reef species radiated out, spreading eastward across the South Pacific islands. But like ripples in a pond, the farther away one gets from that 'center', the fewer the species (see figure). This pattern applies to corals, fishes, sea turtles, seagrasses, mangroves, land birds and plants. Very few species reached here from the opposite direction (South America) probably due to the much greater distance and fewer islands in that direction to facilitate 'island hopping'.

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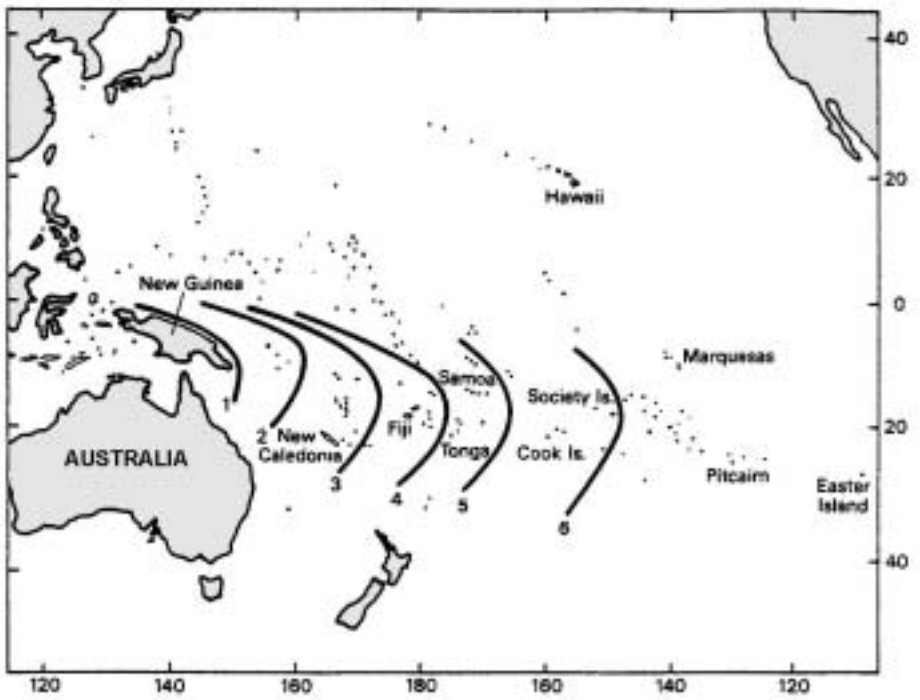


High terrestrial and marine biodiversity in Region 1 decreases across the Pacific towards Region 6.

4. This volcano we live on

The geology of the Samoan islands is surprisingly interesting. First, we are living on a volcano, which is resting quietly at the moment. Second, our volcano is on the move - - it's traveling towards China with us on it. And, finally and most unfortunately, our volcano is doomed and it will eventually sink back into the dark ocean depths.

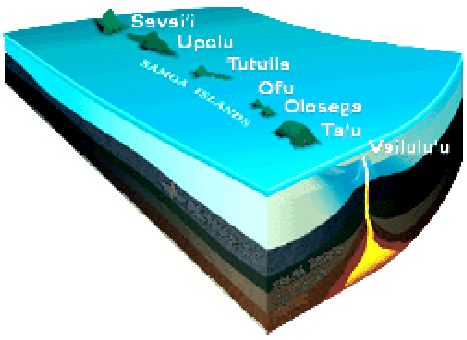
It is not really an exaggeration to call the Samoan islands 'active volcanos'. These islands were indeed formed by volcanism, and the volcanos are still active, in a geologic timeframe of course, and due to some unusual circumstances as described below.

About 1.5 million years ago, our volcano spewed forth enough lava to rise up out of the ocean and become “Tutuila Island”. Actually, just the tip of the volcano is visible to us - - most of the mountain is underwater. While the tallest mountain peak on Tutuila is about one half mile high, the mountain extends another 2 miles below the sea surface.

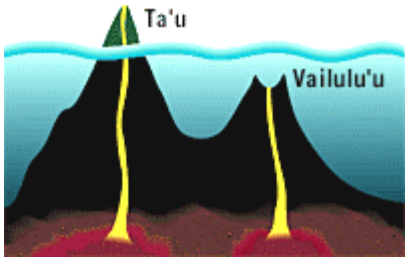
The most recent volcanic eruptions were a lot more recent than many people realize. In western Samoa, major eruptions occurred in 1905 when lava flows destroyed a village. In the Manu'a islands, subsurface volcanic eruptions and earthquakes occurred in 1866, causing dense clouds of smoke and pumice to erupt from the ocean surface for several months. One hundred years ago is just a blink of the eye to a volcano, which measures time in the millions of years. We humans tend to forget how briefly people have lived upon these shores. Human habitation on Tutuila, even considering the whole 3000- year period that Samoans have dwelt here, represents a mere 0.2% of the time since the sun first shone on this new land.

To explain our volcano's march towards China, we first need to review the nature of the earth's surface or crust. The earth's outer layer, the one we live on, is several miles thick, but that is a thin skin compared to the total size of the earth. This outer layer is made up of many separate sections that seemingly float on top of the earth's molten core and move about in very slow motion. Geologists call these outer sections “plates”. You may recall, for example, that the continents of Africa and South America were once joined together when the earth first formed, but the two continents slowly drifted apart to where they are today. The same process applies to the plates under the Pacific Ocean. The plate we're on is called the Pacific Plate and it is moving westward (towards China) at a leisurely speed of about 3 inches per year. At this rate, in one million years we will be 50 miles closer to China.

It is not accidental that the islands of American Samoa and western Samoa lie roughly in a straight line. Directly underneath us is what geologists call a “hot spot” of thermal activity in the earth's core. It's a volcano just waiting to happen. When the pressure builds up at the hot spot, molten magma bursts up through the Pacific Plate and forms a volcanic island. Then the hot spot calms down for awhile, perhaps a million years or so. During this peaceful interval, the Pacific Plate keeps marching onward, so when the hot spot acts up again, it forms a new volcanic island rather

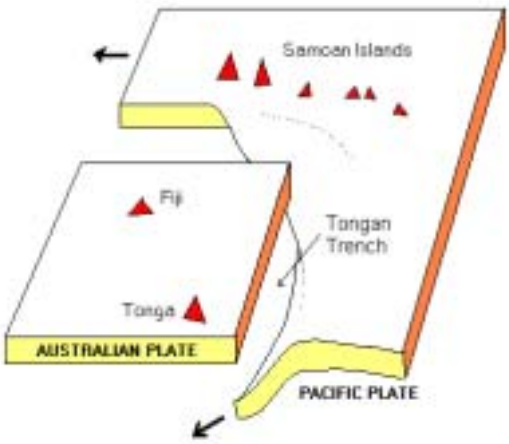


than build upon the previous one. In other words, the hot spot stays in one place but the plate above it keeps moving.



The islands formed therefore generally lie in a straight line that is oriented in the direction the plate is moving. The new islands form on the eastern end of the chain, so the islands become progressively older as you move from east to west. For that reason, the islands in western Samoa are about 1 million years older than the islands in American Samoa. (Early geologists got this direction backwards.) The newest volcanic eruption in our island chain is forming about 30 miles east of Ta'u Island, but it will probably be another 100,000 years before this sub- surface volcano, named Vailulu'u, breaks the sea surface.

But something else really exciting also happens in our area. As Tutuila Island glides westward, a part of our plate collides with another plate to the west of us (the Australian Plate), and our plate actually rips in two at this point (see diagram). One piece of our plate continues moving towards China, but the other piece slides down into the 6- mile deep Tongan Trench and under the Australian Plate, never to be seen again.



The collision of these two colossal pieces of the earth's surface causes the seafloor to bend and rip, which in turn probably causes some earthquakes and renewed volcanic activity. Recent surveys suggest how this might be happening. Long cracks in the seafloor have been discovered between the Samoan islands and the Tongan Trench. The cracks are oriented in an east-west direction and seem to be formed as the seafloor bends southward down into the top of the Tongan Trench. These cracks may make it easier for the hot magma beneath the crust to spew upward and emerge as young lava on top of our old islands.

And all this is happening a mere 100 miles south of Tutuila Island. We live in a very unique area.

Finally, all oceanic volcanos must come to an end. As time passes, two things happen. Our volcano erodes continuously as ocean waves attack its shorelines and rivers gouge into its terrain. In addition, the weight of a newly formed volcano is so heavy that it causes the volcano to sink slowly back down into the sea. Rose Atoll and Swains Island are good examples of sunken volcanos. In the distant past, Rose and Swains may have been magnificent mountainous islands with beautiful rainforests and coral reefs. But that's ancient history now, because those islands, over a period of several million years, eventually sank out of sight. All that remains are tiny amounts of coral that grew up from the peaks of the mountains as they slipped below the sea surface.

Not to worry. Tutuila Island should be around for a few more million years.

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